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~~Tampon, especially for feminine hygiene, and a process and apparatus for producing this.~~

~~background of the INvention~~
The invention relates to a tampon, especially for feminine hygiene, according to the pre-characterizing clause of Patent Claim 1 and to a process and an apparatus for producing the tampon, according to the pre-characterizing clause of Patent Claims 6 and 13.

A tampon of the abovementioned generic type is known from German Auslegeschrift 1,491,161. This tampon has proved appropriate in practice because of its high absorption capacity, fluid retention capacity, rate of absorption, stability and buckling strength. For this, the tampon has longitudinal grooves which are caused by pointed press jaws and on each of the two sides of which occur longitudinal ribs which are pressed to the approximately cylindrical final form of the tampon during a subsequent pressing operation by means of press jaws with partially cylindrical press faces.

~~Summary of the INvention~~
The object on which the invention is based is to improve the tampon of the abovementioned generic type in such a way that the absorption capacity and rate of absorption of the tampon appertaining to the two are essentially maintained, but the specific absorption capacity of the tampon is increased.

~~The invention achieves this object by means of the features contained in the characterizing clause of Patent Claim 1. It was shown surprisingly that a tampon having these features makes it possible to obtain an appreciable increase in the specific absorption capacity (ml/g), whilst preserving the hitherto obtained absorption capacity and rate of absorption, with a surprisingly smaller amount of fibre material being used. This effect is attributable to a coarser capillary structure of the fibre material in the outer layer of the tampon.~~

~~Thus it was found that a tampon according to the invention consisting of 100% rayon fibres with a weight of 2.4 g, without the recovery tape can have a specific absorption capacity of 4.8 ml/g with a rate of absorption of 1.9 ml/s. The absorption capacity of such a tampon can~~

E ~~be obtained~~ at a static counterpressure of 20 mbars ^{is} 11.3 ml. In a test with a pulsating counterpressure of 20 to 110 mbars approximating extremely closely to the practical conditions of use, the absorption capacity of the tampon according to the invention can amount to 8.0 ml and the specific absorption capacity to 3.4 ml/g.

5 The diameter of the tampon is set at between 13 and 15 mm according to the customary physiological conditions, and the central fibre core can preferably have a diameter of 4 to 8 mm. A high buckling strength of 10 the tampon can thus be achieved, whilst at the same time the soft surface of the tampon guarantees a pleasant handling of the tampon.

15 *P* The invention relates, furthermore, to a process for producing this tampon ~~having the features contained in the pre-characterizing clause of Patent Claim 1~~. A process of this type is known from German Auslegeschrift 1,491,161 already mentioned.

20 *D* According to the invention, this process for producing the tampon according to the invention is improved by means of ~~the features contained in the characterizing clause of Patent Claim 6~~.

25 *D* The invention relates, moreover, to an apparatus for producing the tampon and for carrying out the above-mentioned process, ~~having the features contained in the pre-characterizing clause of Patent Claim 13~~. An apparatus of this generic type is likewise known from German Auslegeschrift 1,491,161. According to the invention, this known apparatus is improved ~~by means of the features contained in the characterizing clause of Patent Claim 13~~, with the effect of the best possible production 30 of the tampon according to the invention. The fact that only press cutters are provided on the end faces of the segment-shaped pressed jaws and of the sliding plates guarantees a merely partial pressing of the winding blank to produce a preform which is subsequently subjected only 35 to a weak concentric shaping in the following forming die, thereby providing a smooth, soft and aesthetically pleasing surface of the tampon, but which, despite the

1 use of a smaller amount of fibre material, allows an
5 appreciably increased specific absorption capacity of the
tampon, without the tampon suffering from a loss of
absolute absorption capacity in comparison with the known
tampon mentioned.

The apparatus according to the invention is
advantageously developed by means of the features men-
tioned in the subclaims.

E *Brief Description of the Drawings*

10 The invention is explained in more detail below
by means of the diagrammatic drawing of an exemplary
embodiment of a tampon and of an apparatus for producing
this. In the drawing:

15 *E1* Fig. 1 shows the tampon according to the invention in a
middle longitudinal section along the sectional
line I - I in Fig. 2,

E1 Fig. 2 shows a cross-section ~~II - II according to Fig.~~
Fig. 1,

E2 Fig. 3 shows a cross-section ~~through the preform along~~
the line III - III in ~~Fig. 16~~ *E2* Fig. 8,

E2 Fig. 4 shows a cross-section of the tampon ~~in the~~
~~enlarged representation~~, *E2*

Fig. 5 shows a diagrammatic view of a preforming press
in the opened state with a winding blank arranged
in it,

E1 *E2* Fig. 6 and 7 show a separate closing movement of the
pressing dies, wherein Fig. 6 illu-
strates a first pressing face of the
preforming press with closed press seg-
ments, whilst a second, final press face
of the preforming press is illustrated
in Fig. 7 showing the sliding plates in
the closed position, wherein all press
dies enclose the preform arranged in it,
and

P 1 *Figs.* 8 and 9 show an alternative sequence of movements of the press dies, wherein the press segments and the sliding plates are simultaneously moved into the closed position; Fig. 8 shows an interphase of the pressing procedure and Fig. 9 the press dies completely closed with the preform arranged in it, and

5 Fig. 10 shows a partially sectional side view of the apparatus for producing the tampon with the preforming press and with the

10 following forming die.

E *Description of the Preferred Embodiment*

Figures 1 and 2 show a tampon 10 for feminine hygiene formed from an approximately cylindrical blank 11 which is shaped by winding up a portion of length of nonwoven material, needled if appropriate. The nonwoven can consist of natural or synthetic fibres or of a mixture of such fibres. Natural fibres coming under consideration are preferably those of cotton. Rayon or

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other synthetic fibres are also highly suitable. The circumferential surface of this winding blank is pressed in a way known per se radially relative to the longitudinal mid-axis of the winding blank over an even number of at least six, preferably eight, portions mutually adjacent in the circumferential direction of the winding blank 11.

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According to the invention, these circumferential portions of the winding blank 11 are exclusively narrow strip-shaped portions 12, 13 of the circumferential surface 14 of the winding blank 11 which are arranged at equal angular distances α from one another and which are pressed to produce a preform 15 in Figs. 3, 7 and 8. As seen in cross-section ~~of~~ the preform 15 consists of a central approximately circular fibre core 16 of high compression and stability or buckling strength and of longitudinal ribs 17 extending radially outwards from the fibre core 16 and of a fibre structure softer than that of the fibre core and of correspondingly coarser capillary structure (Fig. 3). The longitudinal ribs 17 are separated from one another by outwardly open longitudinal grooves 18. Only the soft longitudinal ribs 17 of the preform 15 have been exposed to a low uniform ^{radial} pressure ~~radial~~ during manufacture, relative to the longitudinal mid-axis 19 of the preform 15, in such a way that the radially outer ends 20 of the longitudinal ribs 17 form a soft essentially smoothly cylindrical surface of smaller diameter corresponding to the final form of the tampon 10.

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It was found that the tampon according to the invention has a stability 100% higher than that of the known tampon. It was shown, furthermore, that approximately 10% of the fibres used for the tampon can be saved, without any appreciable impairment, if any, of the absorption capacity. In contrast, the rate of absorption is in the upper range of known tampons, whilst the specific absorption capacity is increased appreciably in relation to known tampons.

The following table illustrates a comparative test of the tampon according to the invention consisting of a needled nonwoven composed of 100% of rayon fibres

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from Hoechst AG, and a tampon obtainable in the trade under the commercial designation "Standard O.B.":

Table

	Tampon according to the invention	STANDARD O.B. "Standard o.b." Tampon
10	1. Weight (g) <i>without the withdrawal string without the recovery tape.</i> 2.4	2.7
15	2. Absorption capacity (ml) 20 mbars static counterpressure in test unit 11.3	11.5 - 12.5
20	3. Specific absorption capacity (ml/g) 4.8	4.2 - 4.5
25	4. Rate of absorption (ml/s) 1.9	1.5 - 2.0
30	5. Absorption capacity (ml) in ABTS test unit with pulsating counterpressure of 20 - 110 mbars 8.0	8.6
	6. Specific absorption capacity (ml/g) in ABTS test unit 3.4	3.1

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The absorption capacity values indicated in line 35 2 of the Table were determined in a test unit, in which the tampon is surrounded by an elastic diaphragm which exerts a static counterpressure on the tampon, whilst one end of the tampon is sprinkled with water. This resulted in the specific fluid absorption capacity in ml/g of 40 fibre material of the tampon evident from line 3 of the Table.

The rate of absorption emerging from line 4 was determined in this test arrangement. The values show that, at a weight of the tampon according to the

invention reduced by approximately 10%, the absorption capacity of the tampon is not essentially reduced in relation to the known tampon, the rate of absorption is of the upper limit of that of the known tampon, and the 5 specific absorption capacity is appreciably higher than in the known tampon. Since the specific absorption capacity is evidence of a better utilization of the absorbency of the fibre material per unit weight, it is clear that the tampon according to the invention can be 10 produced more cheaply as a result of the lower weight of material.

Lines 5 and 6 of the Table give values for the absorption capacity and the specific absorption capacity determined in a test arrangement allowing test conditions 15 such as actually occur when the tampon is being worn.

The system designated as ABTS, corresponding to Absorptive Behaviour Test System, is computer-assisted and serves for the acquisition and processing of measurement data regarding the absorption behaviour of absorbent 20 products and for controlling the test cycle.

The test of the tampon is conducted under the following conditions which, as mentioned, occur approximately in vivo:

- chemical/physical compositions of the test fluid
- spacial arrangement of the product, for example 25 inclination
- positioning of the product in the measuring cell
- strength of the flow
- interruption (start/stop) of the flow
- pressure variant.

The test cycle is software-controlled automatically and allows a dialogue between the operator and system. The measurement data are required automatically, 35 their evaluation taking place according to statistical factors. The test cycle for each random sample can be tracked on a video screen by means of a measurement curve and, if appropriate, printed out automatically. Furthermore, the fluid distribution in the product is represented qualitatively and quantitatively. Moreover,

the leakage behaviour of the tampon can be checked. By leakage is meant the phenomenon in which ~~menstruation~~ menstrual fluid can escape between the body wall and tampon. The feed of test fluid to the tampon is carried out exclusively without pressure, since the fluid level is at the height of the test tampon. The fluid is therefore sucked up into the tampon solely as a result of the wetting of the tampon and the wick effect caused by the capillary forces of the latter, and by means of the pulsating counterpressure on the tampon which is felt in practice.

The values determined with this ABTS test device illustrate, in lines 5 and 6 of the Table, that, at the pulsating counterpressure indicated, the absorption capacity of the tampon is only slightly lower than in the reference tampon, but here too the specific absorption capacity of the tampon according to the invention per gram of fibre material is approximately 10% higher than in the reference tampon.

The diameter of the tampon according to the invention is between 13 and 15 mm in its final form. The central fibre core 16 has a diameter of approximately 4 to 8 mm.

Figure 4 shows an enlarged cross-sectional representation of the fibre structure of the tampon according to the invention. It is possible to see clearly the central fibre core 16, from which extend outwards eight longitudinal ribs 17 touching one another at their outer ends 20. The tampon cross-section shows, moreover, that the loose fibre structure with its coarser capillary structure of the longitudinal ribs 17 is preserved, despite the concentric pressure to which these longitudinal ribs are exposed during the production of the final form of the tampon. In contrast, the fibre core 16 having a high fibre compression guarantees a stability or buckling strength which is twice as high as that of the reference tampon and which is of great importance when the tampon is used as a digital tampon.

The figures illustrate an apparatus according to

1 the invention for producing the tampon. According to
Figures 5 to 7, this apparatus consists of two groups of
altogether eight press dies arranged in a plane perpen-
dicular to the press axis 21, the first group of press
25 dies forming press segments 22. In the closing position
shown in Figure 6, the side flanks 23 of these four press
segments 22 form respectively for each of the four press
10 dies of the second group guide surfaces which are design-
ed as sliding plates 24. At the same time, the press seg-
ments 22 and the sliding plates 24 serve, as a preforming
press, for pressing the winding blank 11 to produce the
preform 15 in Figure 7. Exclusively press cutters 27
projecting from the end faces 25 and 26 of the press
15 segments 22 and of the sliding plates 24 serve for
pressing the blank. It is evident from Figures 5 to 7
that the press cutters project from the end faces 25 and
26 of the press segments 22 and sliding plates 24 at
equal angular distances and over the same length. The
shape and dimensions of all the press cutters are identi-
20 cal. The press cutters are therefore also equipped at
their front end with the same pressing faces 28 which, in
the exemplary embodiment illustrated, each extend paral-
lel to the press axis and are curved outwards in the
manner of a semi-cylinder.

25 In the exemplary embodiment, the length and width
of the press cutters 27 radial relative to the press axis
21 amount to 10 mm and 2 mm respectively. In the closed
H state of the preforming press, the pressing faces 28 of
20 the press cutters 27 assume a clear distance of 4 mm from
the press axis 21 (Fig. 19). This distance can also be
25 smaller, for example 2 mm.

25 In contrast with Figs. 6 and 7, a synchronous
30 closing movement of the press segments 22 and sliding
35 plates 24, ~~in the radial direction, related radially to the axis of the press and~~
~~the winding blank, respectively, Fig. 8 shows an~~
~~interphase of this closing movement of the~~
~~press dies, whilst the final closing position of these press dies~~

Figs. 8 and 9 show

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is shown in Fig. 9, ~~which position~~ corresponds to the final dimension of ~~the~~ the preform 15. The simultaneous pressing movement of the press segments 22 and the sliding plates 24 has the advantage, that the geometrical uniformity of the circumferential strip-shaped portions 12 and 13 of the preform 15 will be enhanced. If the tampon is wetted by a fluid the tampon will expand to a more circular shape than in case of the sequential movement of the press dies as shown in Figs. 6 and 7.

If appropriate, however, the press faces can also have a mutually differing shape. If appropriate, the sliding plates can also be designed differently, for example made angular, arrow-shaped or drop-shaped. It is essential that they load and press only a narrow circumferential portion of the blank corresponding approximately to a generatrix. Furthermore, the cycle of movement of the two groups of press dies can, where appropriate, also take place simultaneously or interruptedly in the preforming and post forming and alternately between these two movement actions. Thus, it can be important, according to the process of German Auslegeschrift 1,491,161, first to close all the press dies simultaneously only up to the circumference of the blank 11, in order to centre the blank as exact as possible in relation to the press axis 21, before commencing the actual pressing operation, so as to ensure that the central fibre core 16 comes to rest exactly in the middle of the tampon 10. This is desirable to obtain the highest possible buckling strength or stability of the tampon, above all when the latter is to be used as a digital tampon.

1 According to Fig. 10, the preforming press described is followed by a stationary conical forming die 29. This forming die 29 is arranged coaxially relative to the press axis 21. The entry orifice 30 of the forming die has a diameter ^{of 20 mm} which corresponds approximately to the orifice of the preforming press in the closed state of its press dies which is shown in Fig. 7. The inner face 31 is narrowed towards the cylindrical exit orifice 32 according to an obtuse-angled circular cone, the ~~cross~~
5 ¹⁰ ~~10~~ ^{ES} ~~ES~~ ~~section of the exit orifice 32 corresponding to the final cross-section of the finished tampon 10.~~ Arranged on the input side of the preforming press is a ram 33 which serves for introducing the winding blank 11 into the preforming press and for ejecting the preform 15 through the forming die 29. For this purpose, the ram 33 is arranged movably to and fro coaxially in relation to the press axis 21. Rams of this type are known in the art, and therefore there is no need to represent the driving elements for the ram.

15 The production of the tampon according to the invention by means of the above-described apparatus is carried out according to the following process: the essentially cylindrical winding blank 11 is pressed solely on the narrow strip-shaped portions 12 and 13, arranged at equal angular distances from one another, of the circumferential surface of the winding blank, to

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produce the preform 15 which, as seen in cross-section, consists of the central approximately circular fibre core 16 of high compression and buckling strength or stability and of longitudinal ribs 17 of softer fibre structure 5 extending radially outwards from the fibre core 16. At the same time, the longitudinal ribs 17 are separated from one another by the outwardly open longitudinal grooves 18. Thereafter, only the soft longitudinal ribs 17 of the preform 15 are exposed to a low uniform pressure radial relative to the longitudinal mid-axis of the preform, until the outer ends of the longitudinal ribs have produced a soft essentially smoothly cylindrical surface of smaller diameter corresponding to the final 10 form of the tampon 10. As mentioned, preferably before 15 the actual pressing, the winding blank 11 is centred relative to the press axis 21 of the preforming press as a result of the simultaneous concentric closing of the press segments 22 and sliding plate 24 approximately as far as the circumference of the winding blank.

20 After the pressing of the preform, the latter is ejected through the forming die 29 by means of the ram 33 and thereby brought to the final dimension of the tampon which is determined by the exit orifice 32 of the forming die 29.